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Running Head: EXPLANATION GENERALITY

Preferences for Explanation Generality Develop Early in Biology, but not Physics

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Abstract

One of the core functions of explanation is to support prediction and generalization. However, some explanations license a broader range of predictions than others. For instance, an explanation about biology could be presented as applying to a specific case (e.g., “this bear”) or more generally across “all animals.” The current study investigated how 5- to 7-year-olds ($N=36$), 11- to 13-year-olds ($N=34$), and adults ($N=79$) evaluate explanations at varying levels of generality in biology and physics. Findings revealed that even the youngest children preferred general explanations in biology. However, only older children and adults preferred explanation generality in physics. Findings are discussed in light of differences in our intuitions about biological and physical principles.

Explanations for scientific phenomena are often considered superior when they are more general. Indeed, science might be described as extrapolating from individual cases to the most general claims possible. Similarly, in everyday life, seeking explanation generality can be beneficial (Lombrozo, 2012): General explanations group together similar instances, thereby reducing focus on the idiosyncrasies of each case and highlighting the shared factors that are most relevant (e.g., Friedman, 1974; Kitcher, 1981; Strevens, 2009; Williams & Lombrozo, 2010). More broadly, general explanations offer a framework for drawing inferences across many circumstances, as they apply to a wide range of cases (Gelman, Star, & Flukes, 2002). Thus, an explanation that pertains across all members of a category (e.g., all bears) licenses a wider range of predictions about new cases than an explanation that only pertains to one particular member of a category (e.g., this bear).

In some circumstances, even young children understand the utility of explanations that provide the basis for a wider range of predictions. Most notably, children as young as 5 prefer explanations that account for a greater number of observed outcomes. For instance, when watching an animal undergo a series of magical changes (e.g., a pig that grows whiskers on its face and stripes on its ears), 5- to 8-year-olds prefer broad explanations that account for both observed outcomes over narrow explanations that only account for only one observed outcome (Johnston, Johnson, Koven, & Keil, 2016). Likewise, when witnessing a set of reactions in a chemistry experiment, 7- to 11-year-olds prefer broad explanations that account for the full set of observed reactions over narrow explanations that only account for some of the observed reactions (Samarapungavan, 1992). Thus, when evaluating explanations for a specific set of observations, children seek explanatory breadth, preferring explanations that account for as many observations as possible.

However, a preference for explanatory *breadth* does not necessarily translate into a preference for explanation *generality*. To evaluate explanatory breadth, children need only consider the *specific* set of outcomes concerning a particular individual (e.g., whether *this* pig grew whiskers and stripes). In contrast, to evaluate explanation generality, children need to expand their scope beyond the current set of outcomes to consider how the explanation applies across an entire category (e.g., *all* pigs or *all* animals). Given this distinction between breadth and generality, prior work does not directly address the issue of whether children would prefer more general explanations; however, it does provide some suggestive hints.

First, when *producing* explanations for statements of varying levels of generality, children demonstrate distinct intuitions about the implications of specific, token level statements (e.g., “This snake has holes in its teeth”) and more general generic statements (e.g., “Snakes have holes in their teeth;” Cimpian & Markman, 2009). Thus, when asked to explain features of different animals (e.g., “Why does this snake have holes in its teeth?”), 4- and 5-year-olds who are prompted with generic statements (rather than token-level statements) are (a) more likely to explain the features in terms of conceptually-central causes (e.g., “to drink the blood out of predators”) and (b) less likely to explain them in terms of prior events (e.g., “maybe yesterday he got poked in the teeth”; Cimpian & Markman, 2009). Similarly, when explaining features of novel artifacts (e.g., “Why is this dunkel sticky?”), 5-year-olds (but not 4-year-olds) are more likely to explain the features in terms of their functionality when hearing generic statements than token level statements (Cimpian & Cadena, 2010). These findings suggest that even young children expect that, compared to statements about a specific token, generic statements provide more conceptually central information about a general category. Given that children expect that generic statements provide more conceptually central information than token level statements,

they may prefer generic explanations (which clarify that information is conceptually central to an entire category) more than token level explanations (which imply that information is idiosyncratic and unique to a particular token).

Second, and most crucially for the current study, children expect that generic information will extend more widely than token level information. Even 2-year-olds, when introduced to a novel property, are more likely to infer that the property extends to other category members when learning from generic language (e.g., “Blicks drink milk”) than specific, token level language (e.g., “This blick drinks milk;” Graham, Nayer, & Gelman, 2011; see also, Chambers, Graham, & Turner, 2008). In fact, by age 4, children are sensitive to even more nuanced distinctions in the relation between language and scope, inferring that universally quantified noun phrases (e.g., “*All* bears”) extend more widely than generics (e.g., “*Bears*;” Brandone, Gelman, & Hedglen, 2015; Gelman, Leslie, Was, & Koch, 2015; Gelman et al., 2002; Hollander, Gelman, & Star, 2002). Thus, by age 4, children have robust expectations that generic statements and universally quantified noun phrases apply more widely across category members than specific, token level statements.

Given that children understand that universally quantified noun phrases apply more widely across categories than token level statements, might children also prefer universally quantified noun phrases as *explanations*, since they more efficiently explain a wider scope of phenomena in just one explanation? The current study aims to address this question by testing whether children prefer explanations that apply widely across categories (e.g., explanations about “all bears”) or more specifically to a particular token level case (e.g., explanations that apply to “this bear”). To do this, we examine whether children prefer explanations that explain an event about a particular token (e.g., *this bear*) in terms of an explanation at the token level (e.g., “this

bear”), the basic level (e.g., “all bears”), or the superordinate level (e.g., “all animals”). If children’s preference for explanatory breadth (Johnston et al., 2016; Samarapungaven, 1992) translates into a more abstract notion of scope that extends across an entire category, then children should consistently prefer the most general explanations presented (e.g., about “all animals”). In contrast, if children’s preference for wider scope in explanations is restricted to more concrete, token exemplars, then children may not demonstrate a preference for explanation generality, and may instead demonstrate a preference for specificity (e.g., explanations about “this bear”), or no preference at all. Alternatively, children may show a different preference entirely – for basic level explanations. Prior work has shown that from preschool to adulthood, there is a bias to remember (Gülgöz & Gelman, 2015), learn about (Mervis & Crisafi, 1982; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976), and generalize to (Gelman & Reilly, 1988) basic level categories. If this bias towards the basic level extends to explanation as well, then we should find evidence that children prefer basic level explanations more than either token level or superordinate explanations.

In addition to exploring children’s explanatory preferences across these three levels (i.e., token, basic, and superordinate), we also explore their preferences across two domains—biology and physics. The principles in these domains (e.g., respiration vs. gravity) and the typical targets (e.g., bears vs. hammers) have psychologically important distinctions.

Biological kinds, particularly animals, are in large part defined by a shared set of underlying biological principles (e.g., respiration, digestion, etc.). Even 3- and 4-year-olds recognize the presence of these shared biological principles and readily extend information about one animal (e.g., that a particular bug breathes in air) to other individuals of the same kind (e.g., Gelman & Markman, 1986, 1987). In other words, 3- and 4-year-olds infer that a biological trait

one animal possesses will be shared across other animals of that kind. This early awareness that animal kinds share a set of underlying biological principles may help young children recognize the utility of general explanations, which allow for prediction across all members of a kind.

In contrast, although there are general principles of physics that apply to all things (e.g., gravity), physical kinds, especially human-made artifact kinds, are primarily defined by differences in how they function, rather than a shared set of underlying physical principles. Even young children understand that artifact kinds are less predictive than animal kinds. Not only are young children less likely to provide generic statements for artifact kinds (e.g., hammers) than animal kinds (e.g., bears; Brandone & Gelman, 2013), but they also are less likely to assume that information about one member of an artifact kind will extend to another member of the same kind (Gelman, 1988). Thus, in order for children to appreciate the utility of explanation generality in physics, they cannot rely on their expectations about the predictive nature of artifact kinds. Instead, children need to understand the utility of explanations that invoke general principles (e.g., gravity), which apply broadly across individual objects. Given that children cannot rely on the predictive nature of artifact kinds in the physical domain, they may fail to recognize the utility of explanation generality in physics until later development.

We investigated these preferences for explanation generality in biology and physics across three age groups: 5- to 7-year-olds, 11- to 13-year-olds, and adults. Five- to 7-year-olds clearly differentiate between specific and generic language (e.g., Cimpian & Cadena, 2010; Gelman et al., 2002; Graham et al., 2011), show reliable explanatory preferences (particularly for explanatory breadth; Johnston et al., 2016; Samarapungaven, 1992), and conceptualize animal and artifact categories differently (e.g., Gelman, 1988; Rhodes & Gelman, 2009), making them an appropriate younger age group for the current investigation. However, given that some

research has shown that children do not begin to show adult-like explanatory preferences until age 11 (Samarapungaven, 1992), we also included a group of 11- to 13-year-olds and a group of adults in our sample.

Method

Participants

Thirty-six 5- to 7-year-olds ($M_{Age} = 6$ years 8 months; range = 4 years 12 months - 7 years 12 months; 9 5-year-olds, 11 6-year-olds, 16 7-year-olds; 21 females), 34 11- to 13-year-olds ($M_{Age} = 12$ years 1 month; range = 10 years 8 months to 13 years 12 months; 19 11-year-olds, 8 12-year-olds, 7 13-year-olds; 21 females), and 79 adults (recruited from Amazon Mechanical Turk) participated in the study, conducted from June to October 2014. The children were recruited from our lab database and a local science museum in a Northeastern metropolitan area with a median income of \$62,000. The region's population distribution is as follows: 79% White, 14% Black, 4% Asian, and 3% other races, with approximately 17% identifying as Hispanic.

Design and Procedure

For each domain, we developed explanations for nine phenomena that were broadly applicable to either all animals or all things. For biology, we developed explanations for circulation, digestion, hydration, immunity, inheritance, movement, respiration, sight, and waste. For physics, we developed explanations for atomic structure, color, decay, displacement, gravity, inertia, molecular movement, opacity, and phase change. For a full list of explanations, see Table 1.

Participants either evaluated all nine biology items or all nine physics items. To ensure there were no systematic differences between participants in the two conditions, we randomly

assigned participants by alternating between the conditions. For each item, the experimenter presented a photo of a single animal or artifact in a naturalistic background (e.g., a bear in a meadow) and then stated an observation about that animal or artifact (e.g., *“This bear looks like its parents”*). After making this observation, the experimenter said, *“Here are two explanations for this. Both are true. Which one do you think is most helpful?”* We emphasized that both explanations were true in order to ensure participants were focusing on the scope of the explanations rather than their truth value. Additionally, we prefaced each of the two explanations with the phrase “Is it because...” in order to highlight the explanatory nature of the task.

Each item had three potential levels of explanation—token (e.g., *“This bear is made from a mixture of ingredients from its parents”*), basic (*“All bears...”*), and superordinate (*“All animals...”*)—but participants were only presented with a subset of two of these explanations for each item. We chose to use universally quantified noun phrases (e.g., *“All bears”* rather than *“bears”*) to ensure that any domain differences were not driven by differences in participants’ inferences about the scope of the statements. To help reduce the memory load for young children, each explanation was presented along with an image that represented the level of explanation. See Figure 1 for sample images.

To determine which animal or artifact would be featured in each item, we developed a list of 9 basic level animal categories (i.e., bears, cats, fish, frogs, parrots, penguins, sharks, snakes, turtles) and 9 basic level artifact categories (i.e., balls, cars, chairs, cups, hats, planes, shirts, spoons, tables) and randomly assigned one basic level category to each item. The pairing between item and basic level category was kept consistent across participants. The order of the items, the subset of explanations presented for each item, and the order in which the explanations were presented within each item were counterbalanced. Most crucially, each participant received

each of the three explanation pairings (i.e., superordinate vs. basic; superordinate vs. token; basic vs. token) three times over the course of the study.

Results

Our major results can be seen in Figures 2 and 3. As shown in these figures, children demonstrate an early-emerging preference for explanation generality in biology, but a later-developing preference for explanation generality in physics.

As a preliminary analysis, we investigated whether participants' preferences for explanation varied as a function of age, domain, or explanation level. Specifically, we conducted a partially repeated-measures ANOVA. Age (5–7, 11–13, and adult) and domain (biology and physics) were between-subjects factors and explanation level (token, basic, superordinate) was a within-subjects factor. We found a significant effect of explanation level, $F(2, 142) = 44.82, p < .001, \eta^2 = .387$, as well as interactions between explanation level and age, $F(4, 286) = 3.24, p = .013, \eta^2 = .043$, explanation level and domain, $F(2, 142) = 3.25, p = .042, \eta^2 = .044$, and explanation level, age, and domain, $F(4, 286) = 2.13, p = .078, \eta^2 = .029$. Given that we found a marginally significant three-way interaction between explanation level, age, and domain, we analyzed the results for each domain and age group separately.

Biology

To examine whether participants' explanatory preferences varied as a function of explanation level in biology, we conducted post-hoc Bonferroni tests for each age group (with a corrected alpha level of .017) comparing participants' preference for each explanation level. Participants in each age group preferred superordinate and basic level explanations more than token level explanations ($ps < .007, ds > 0.74$). However, neither the 5- to 7-year-olds, $t(17) = 1.38, p = .186, d = 0.32$, nor the 11- to 13-year-olds, $t(16) = 1.79, p = .092, d = 0.44$, showed a

significant preference between the basic and superordinate level explanations, and adults only showed a marginally significant preference (compared to the corrected alpha level of .017) for superordinate level over basic level explanations, $t(38) = 2.16$, $p = .037$, $d = 0.35$. See Figure 2.

Single sample t -tests comparing each of these levels to chance revealed that participants in all age groups preferred the superordinate level explanations significantly more than chance ($ps < .013$, $ds > 0.65$) and also preferred the token level explanations significantly less than chance ($ps < .004$, $ds > 0.81$). In fact, adults not only preferred the superordinate level explanations more than chance, but they also significantly preferred the basic level explanations more than chance, $t(38) = 4.11$, $p < .001$, $d = 0.66$. These results demonstrate that, although participants in all age groups typically preferred the most general explanations in biology, they showed some preference for basic level explanations as well. Specifically, children in both age groups showed similar overall preferences for superordinate and basic level explanations and adults even showed a significant preference for basic level explanations above and beyond their preference for explanation generality.

To provide additional clarification on our results, we also examined participants' preferences within each explanation pairing separately (i.e., token vs. basic, token vs. superordinate, and basic vs. superordinate). For each pairing, we calculated the number of times (out of 3) participants chose the more general level. Single sample t -tests revealed that participants in all age groups preferred the basic level over the token level explanations in biology ($ps < .005$, $ds > 0.80$), and also preferred the superordinate level explanations over the basic level explanations ($ps < .044$, $ds > 0.53$). However, only the 11- to 13-year-olds and adults significantly preferred the superordinate level explanations over the token level explanations (ps

$< .004$, $ds > 0.86$). See Figure 3. These results provide additional evidence that children and adults have a preference for explanation generality in biology.

Physics

As in biology, we conducted post-hoc Bonferroni tests for each age group (with a corrected alpha level of .017). The 5- to 7-year-olds showed no significant difference in their preference between the three levels ($ps > .205$, $ds < 0.53$). In contrast, both 11- to 13-year-olds and adults preferred the superordinate level more than both the basic level ($ps < .008$, $ds > 1.09$) and the token level ($ps < .001$, $ds > 1.98$). Likewise, 11- to 13-year-olds, $t(16) = 2.39$, $p = .029$, $d = 1.06$, and adults, $t(39) = 3.58$, $p = .001$, $d = 0.93$, preferred the basic level more than the token level, though this preference was only marginally significant ($p > .017$) for the 11- to 13-year-olds. See Figure 2.

Single-sample t -tests comparing each of the three levels of explanation to chance revealed that 11- to 13-year-olds and adults preferred the superordinate level significantly more than chance ($ps < .001$, $ds > 2.23$), the basic level no differently from chance ($ps > .140$, $ds < .49$), and the token level significantly *less* than chance ($ps < .003$, $ds > 1.81$). The 5- to 7-year-olds showed no significant preference for any of the three levels ($ps > .133$, $ds < 0.77$). These results demonstrate that 11- to 13-year-olds and adults showed a consistent preference for the superordinate level explanation in physics, but 5- to 7-year-olds did not distinguish between the three levels of explanation in their preferences.

As in biology, we also examined participants' preferences within each explanation pairing separately (i.e., token vs. basic, token vs. superordinate, and basic vs. superordinate). Single sample t -tests revealed that 11- to 13-year-olds and adults showed a generality preference for each of the pairings ($ps < .008$, $ds > 0.74$). In contrast, 5- to 7-year-olds only showed a

significant preference for generality when comparing the token and basic levels, $t(17) = 2.53$, $p = .022$, $d = 0.60$. See Figure 3. Together, these results suggest that 11- to 13-year-olds and adults had a robust generality preference in physics that extended across each of the explanation pairings. In contrast, 5- to 7-year-olds only showed a preference for generality when the basic level was pitted against the token level and never showed a preference for the most general superordinate level. Taken together, our results suggest that 5- to 7-year-olds only show a secure grasp of explanation generality in biology: Although 5- to 7-year-olds preferred basic level explanations over token level explanations in both domains, they only preferred the most general superordinate explanations in biology.

Discussion

A core function of explanation is to provide a useful platform for prediction and generalization. Our findings demonstrate that children are already beginning to recognize the utility of explanation generality by age 5. Regardless of whether children are asked to evaluate explanations in biology or physics, they prefer basic level explanations (e.g., that invoke “all hats”) over the more specific token level explanations that invoke a particular instance of a category (e.g., “this hat”). In fact, when evaluating explanations in biology, 5- to 7-year-olds are able to go a step further and indicate that superordinate explanations that invoke “all animals” are better explanations than those that invoke more narrow basic level categories (e.g., “all bears”). This quest for explanation generality is useful because it provides children with the opportunity to draw inferences across a wider range of situations and thus learn more efficiently.

However, the preference for explanation generality remains somewhat tentative until later childhood. Although young children seem to prefer basic level explanations over token level explanations regardless of domain, their preference for the most general superordinate level

remains weak until after age 7. In physics, 5- to 7-year-olds never showed a preference for the superordinate level, regardless of whether it was contrasted with the token level or basic level, and in biology, 5- to 7-year-olds only preferred the superordinate level when it was contrasted with the basic level. Crucially, although 5- to 7-year-old children's preference for the superordinate level was relatively weak in both domains, they only showed a significant preference for the most general superordinate level in biology. The different pattern of results for biology and physics suggests that children's ability to recognize the utility of explanation generality depends on the explanatory domain.

Although further work is needed, prior research provides some insight into what might be driving the developmental differences we see in children's generality preferences across domain. In particular, young children may better understand the predictive power offered by general explanations in biology than in physics. From a very early age, children are already beginning to understand the predictive power of animal kinds. Before age 5, children have robust expectations that information about one member of an animal kind will extend to other members of the same kind (e.g., Gelman & Markman, 1986, 1987). Crucially, this expectation that information will apply widely across categories applies to the exact sort of biological principles we used in our study. For instance, when 3- and 4-year-olds learn that one type of bug breathes in air, they are likely to assume that another bug of a similar type will breathe in air as well (e.g., Gelman & Markman, 1986, 1987). Thus, even young children understand that animal kinds provide the basis for useful predictions about novel cases.

One of the most useful aspects of general explanations is that they provide the basis for prediction across a wide range of cases. In the domain of biology, an explanation about all animals not only allows children to gain insight about "this bear," but "this fish" as well. Given

that children have an early understanding of the predictive nature of animal kinds (e.g., Gelman & Markman, 1986, 1987), this may have bolstered their ability to recognize the utility of explanation generality in biology. If children understand that a general explanation about all animals allows future predictions about a wide variety of animals, then they should have an easier time recognizing its utility as an explanation.

Although young children can rely on the predictive nature of animal kinds to infer the utility of general explanations in biology, they cannot rely on their understanding of non-living kinds to infer the utility of general explanations in physics. In contrast to animal kinds, which are in large part defined by the biological principles they share (e.g., respiration), physical kinds, especially the specialized artifacts humans create, are in a large part defined by the differences in how they function (e.g., what a child is taught about how to use a hammer may be completely unrelated to the proper way to use a knife). Even young children seem to be sensitive to this distinction between non-living kinds and animal kinds. Not only are young children less likely to provide generic statements for non-living kinds (e.g., hammers) than animal kinds (e.g., bears; Brandone & Gelman, 2013), but they are also less likely to assume that information about one member of a non-living kind will extend to another member of the same kind (Gelman, 1988). Thus, even young children recognize that non-living kinds are less predictive than animal kinds.

Given that children cannot assume that information about one non-living kind is predictive of other members of that kind, the structure of the inference children need to make about explanation generality in physics is different than that of biology. To understand the utility of explanation generality in physics, children need to understand the predictive power of a set of *external* principles (e.g., gravity) that enact on all objects regardless of category membership.

Five- to 7-year-olds in our study may have struggled to recognize the utility of explanation generality in physics because they did not recognize the predictive nature of general physical principles. Until the age of 8, children often conceptualize physical forces as internal forces emitting from a particular object (Ionnides & Vosniadou, 2002). It is not until sometime between age 8 and 12, that children start to understand that forces are externally applied, rather than internally driven. Given that young children are hesitant to generalize information from one member of a non-living kind to another (e.g., Brandone & Gelman, 2013; Gelman, 1988), they may not recognize the predictive power of general physical principles until after age 8 when they begin to see them as generalize external forces, rather than forces that emit from individual objects.

However, it is important to consider an alternate explanation for our developmental differences. We chose to use naturalistic stimuli in our study since prior work has suggested that young children may struggle when considering explanations for novel exemplars (e.g., Cimpian & Cadena, 2010; c.f., Cimpian & Markman, 2009). Although our naturalistic stimuli may have improved children's performance in some respects, it also inevitably introduced potential discrepancies in children's background knowledge. One account of the domain differences we see in the 5- to 7-year-old age group is that these young children may have been more familiar with the biological principles than the physical principles in our explanations, and thus better able to evaluate the biological explanations. Although 5- to 7-year-olds showed some distinction in their preference for the physical explanations (i.e., they preferred basic-level explanations over token-level explanations), they showed less distinction in their preferences in physics than they did in biology. Thus, is it possible that children's familiarity with biological and physical principles influenced their explanatory preferences in some way. Future work should address this

issue by examining children's generality preferences for novel biological and physical explanations.

Even young children appreciate explanation generality in some contexts, and crucially they never prefer specificity. However, children do not begin to consistently apply their preferences for explanation generality until after age 7. When explanations invoke highly predictive categories, such as animal kinds, even 5- to 7-year-olds prefer general explanations (e.g., about "all animals") that license prediction across a wide range of token members (e.g., this bear, fish, snake, etc.). However, when explanations invoke categories that are less predictive, such as artifact kinds, children do not prefer general explanations (e.g., about "all things") until after age 7, when they begin to appreciate the predictive power of external physical principles (e.g., gravity, inertia, etc.). Thus, it seems there is an early-emerging preference for explanation generality, and this preference is applied more broadly as children learn which explanations provide the most predictive power.

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Concept	Observation	Explanation
Circulation	This parrot has blood running through its body.	All animals have hearts that pump blood through their bodies.
Digestion	This cat gets energy from its food.	All animals break food into tiny pieces to get energy.
Hydration	This penguin's insides are in balance.	All animals have water inside of them that keeps their insides in balance.
Immunity	This frog gets better after being sick.	All animals have little fighters in their bodies that attack bad things that make them sick.
Inheritance	This bear looks like its parents.	All animals are made from a mixture of ingredients from their parents.
Movement	This snake moves around.	All animals have muscles that stretch and shrink to change the position of their bodies.
Respiration	This fish has oxygen in its body.	All animals have organs in their body that pull in oxygen from their environment.
Sight	This turtle sees what's in front of it.	All animals have eyes that turn light into a picture.
Waste	This shark only keeps the parts of food that it needs.	All animals go potty, which gets rid of the parts of food they don't need.
Atomic Structure	This ball takes up space.	All things are made of tiny parts that take up space.
Color	This chair has color.	All things are the color of the part of the light they reflect.
Decay	This table slowly turns to dust over time.	All things break down into smaller pieces and eventually the pieces become so small we can't see them anymore.
Displacement	This hat can't be in the same place as something else.	All things take up their own space, so when another object tries to fill the same space, they push each other away.
Gravity	This plane is pulled toward the Earth.	All things are pulled by Earth's gravity.
Inertia	This cup stays in the same place.	All things stay still until something moves them.
Molecular Movement	This spoon gets harder in the cold.	All things have little pieces that hold together more closely when it is cold.
Opacity	This car leaves a shadow.	All things leave a shadow when they keep light from passing through them.
Phase Change	This shirt turns to smoke in fire.	All things turn to gas when they get really really hot.

Table 1. Full list of observations and explanations. Biological items are above the solid black bar and physics items are below the solid black bar. For simplicity, we just present the superordinate explanations here that invoke “all animals” and “all things.”

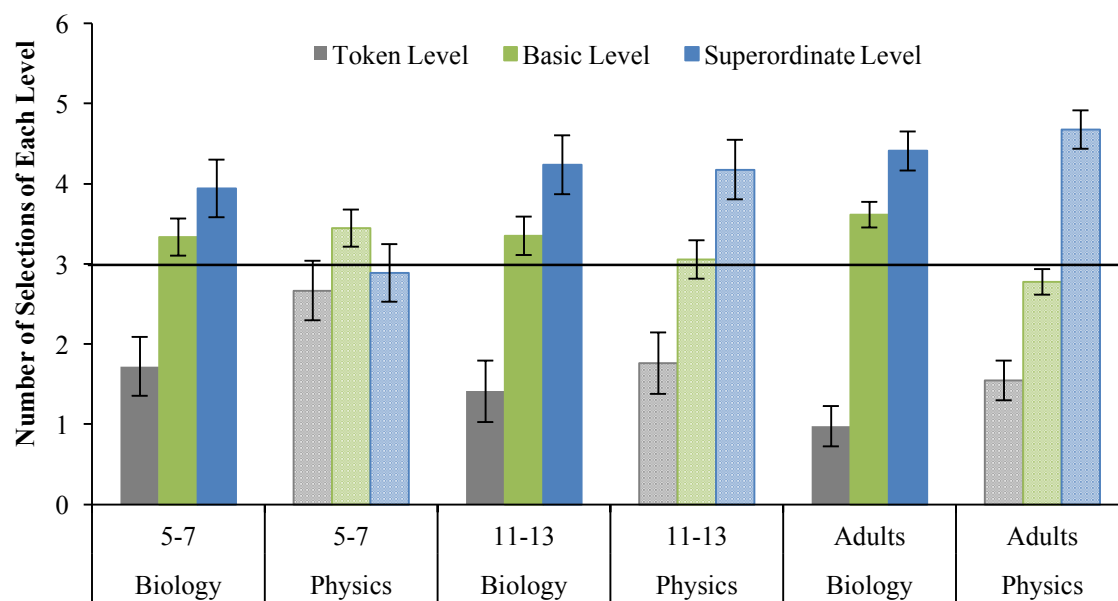


Figure 2. Mean number of times participants selected each explanation level (i.e., token level, basic level, and superordinate level) in biology and physics. Horizontal line demonstrates chance performance. Error bars represent standard error.

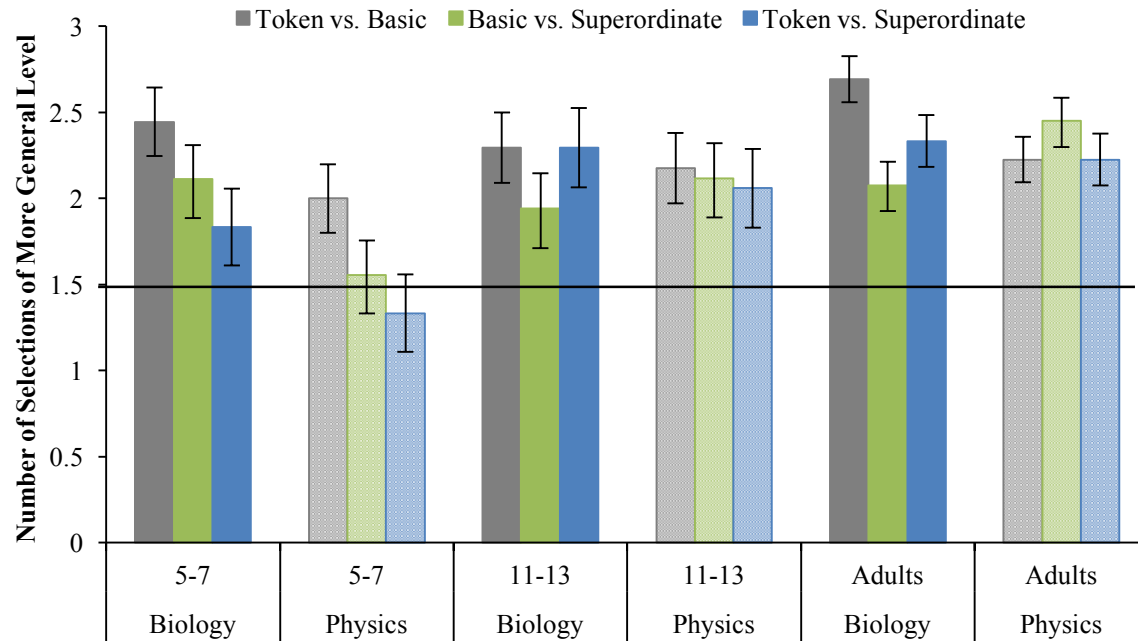


Figure 3. Mean number of times participants selected the more general level in each explanation pairing – token vs. basic (more general = basic), basic vs. superordinate (more general = superordinate), and token vs. superordinate (more general = superordinate) – in biology and physics. Horizontal line demonstrates chance performance. Error bars represent standard error.